LESSONS LEARNED WITH THE INNOVATION TRIANGLE INITIATIVE

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ABSTRACT:

One of the roles of ESA is to support the introduction of technology innovation in the space environment. This is the aim of the Innovation Triangle Initiative (ITI), whose specific goal is to explore technologies or services for space applications *that are not currently being used or exploited in the context of space* and have therefore the potential of being the seed for significant innovation.

ITI is based on the concept that a close collaboration between three different types of entities: the inventor, the developer and the customer, is an important factor for the rapid and successful introduction of technology innovations in industry.

Following a successful pilot phase, the operational phase of ITI, based on a WEB application - http://iti.esa.int/, was officially launched on 16th March 2004 with a funding of 1.5 MEURO for 2004.

The objective of this presentation is to present the ITI concept, the results achieved during the first year of operation of ITI, the lessons learned and the ITI implementation for 2005.

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1 INTRODUCTION

One of the roles of ESA is to support the introduction of technology innovation in the space environment. This is the aim of the ESA Innovation Triangle Initiative (ITI), whose specific goal is to explore technologies or services for space applications *that are not currently being used or exploited in the context of space* and have therefore the potential of being the seed for significant innovation.

The ITI was officially launched on 16 March 2004, and since then has supported the identification, validation and development of space technologies based on new ideas or concepts. As a balance of its first year of operation, ITI has proved to be a valuable and efficient mechanism to rapidly launch R&D activities for space applications. ESA has therefore decided to continue ITI in 2005.

2 THE BASIC THEORETICAL PRINCIPLES OF ITI

2.1 *The Innovation Triangle concept*

The philosophy behind ITI is to put together inventors, producers and end-users of space technologies. By combining the creativity of the inventor, the experience of industry and the needs of the customer, one creates the conditions and synergies to rapid verify the potential and feasibility of new ideas for novel products, technologies and services for space systems.

This "Innovation Triangle" concept was discussed in a survey on R&D best practices [1], which points out that "*Companies worldwide continue to shift toward acquiring more key technology from outside, relying increasingly upon universities for research and on joint ventures and alliances for development*". In other words, in many industry sectors "successful innovation" often comes from improved information exchange between three key players. Namely:

1) The customer (usually a company well-established in the market)
2) The technology developer (the R&D unit of the customer or an external SME)
3) The innovation source (a University or an external Research Centre not necessarily from the same field of expertise).

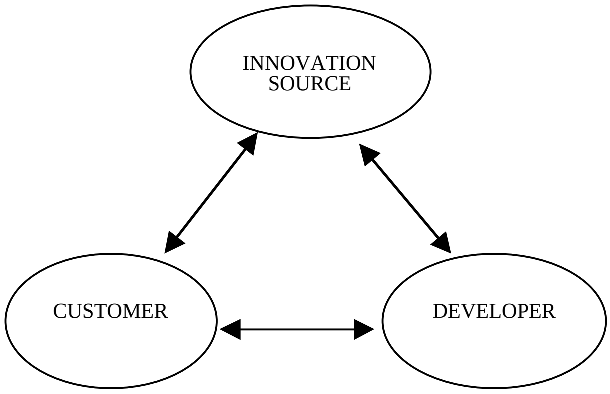


Figure 1 - The Innovation Triangle concept

The Innovation Triangle structure can bring considerable advantages to the innovation process by profiting from the complementarity of the different organizations involved. The bigger companies (The CUSTOMER) can focus on the short-term market needs (sustaining innovation) while at the same time having access to several state-of-the-art innovative concepts (disruptive innovation) with a minimum effort and cost. The

DEVELOPER gains new businesses while ensuring that the general requirements of industry are satisfied so that a reduced time-to-market is achieved. The SOURCE OF INNOVATION has direct access to the CUSTOMER needs but is not directly constrained by the reality of the industrial environment and can therefore freely pursue (disruptive) innovative concepts.

2.2 *ITI and the concept of Disruptive vs. Sustaining Innovation*

A structure of the type described in the previous section can indeed give to industry the ability to explore in parallel a number of separate potential technologies, processes or products and to rapidly absorb, and transform into revenues, the ones that prove to be successful. This is particularly relevant in the case in which the R&D activity involves areas that are not in the "core business" of the industry, as it is often the case for disruptive technology innovation.

The concept of "disruptive innovation" was developed essentially by Prof. Clayton M. Christensen in "*The Innovator's Dilemma*" [2], which explains why well-run companies find it so difficult to respond to what Christensen termed "disruptive innovations". As defined by Prof. Christensen, disruptive innovations are technologies or business models that allow companies to offer simpler, less expensive products or services than have not been offered before in a given environment. Often these are not absolute innovations or novelties but clever repackaging of old technology.

This subtle but important difference between disruptive and breakthrough innovations is clearly present in ITI: One specific goal of ITI is to explore technologies or services for space applications not currently being used or exploited in the space context, and which have the potential of being seed for significant innovation.

In the space sector, the difficulties to introduce "disruptive innovations" are quite high! Although the value of innovation is well understood in the space environment, there are key differences between space and consumer industries, which contribute to making space innovation a difficult issue: space activities involve smaller markets and substantial higher risks. Consequently, innovative ideas often run the risk of being not properly evaluated or even totally discarded at an early stage, without the opportunity to find their way to profitable space products or applications.

This is particularly true for *disruptive innovations* (as opposed to *sustaining innovations*) because space industries and operators are culturally more risk-averse and traditionally more focused on short-term improvements and results, and usually do not have the time or the resources required for more aggressive innovative actions. In this context, it is therefore important for ESA to provide support to industries in rapidly moving disruptive space innovation concepts from the "good idea" stage to profitable industrial applications.

With ITI, ESA answers this need by actively creating and supporting R&D projects organized as described in Fig. 1.

2.3 *ITI and the concept of Stage-Gate Process*

The *Stage-Gate* concept (currently a quite 'hot' topic in the R&D management area) is also present in ITI. The advantages of a Stage-Gate approach, to efficiently manage a portfolio of innovative R&D projects, have been identified by Robert G. Cooper ([3] to [6]).

As mentioned by Cooper in [6], it is interesting to observe that the space sector (namely NASA in the 1960s) pioneered the adoption of phased R&D programs. Due essentially to the specificities of the space environment, the full development of a new space technology (until it is space qualified) is a long and expensive exercise. Therefore, one of the objectives of ITI is to reduce the time, cost and risk required for a new (disruptive) technology, process, or service to reach the level of maturity needed for utilisation in space activities.

In this context, ITI is focused mainly on the initial stage of proving the concept up to demonstrating its feasibility through development of prototypes to be tested in a relevant environment, which, in space terminology, corresponds to a Technology Readiness Level (TRL) 5.

The TRL is a scale used by major Space Agencies to describe the maturity of a Technology. The scale goes from Level 1 through Level 9, as shown below:

Level 1:	Basic principles observed and reported.
Level 2:	Technology concept and/or application formulated.
Level 3:	Analytical & experimental critical function and/or characteristic proof-of-concept.
Level 4:	Component and/or breadboard validation in laboratory environment.
Level 5:	Component and/or breadboard validation in relevant environment.
Level 6:	System/subsystem model or prototype demonstration in a relevant environment (ground or space)
Level 7:	System prototype demonstration in a space environment.
Level 8:	Actual system completed and "Flight qualified" through test and demonstration (ground or space).
Level 9:	Actual system "Flight proven" through successful mission operations.

Table 1 –Technology Readiness Level (TRL)

From an industry perspective, the bottleneck for space R&D funding occurs mainly at the early stages. Therefore, an innovation successfully validated through ITI can aspire to find easier funding and support for the following stages, either from well-established space companies, National Space Agencies or even within other ESA initiatives. In this context, therefore, people with bright novel ideas for space applications can see ITI as an 'entry door' for institutional and industrial support.

3 THE KEY ASPECTS IN THE IMPLEMENTATION OF ITI

The key aspect of ITI is the simple and efficient procedure for submitting and evaluating proposals. Entities interested in participating to ITI must submit their proposals using the templates provided in the ITI Web site - https://iti.esa.int/.

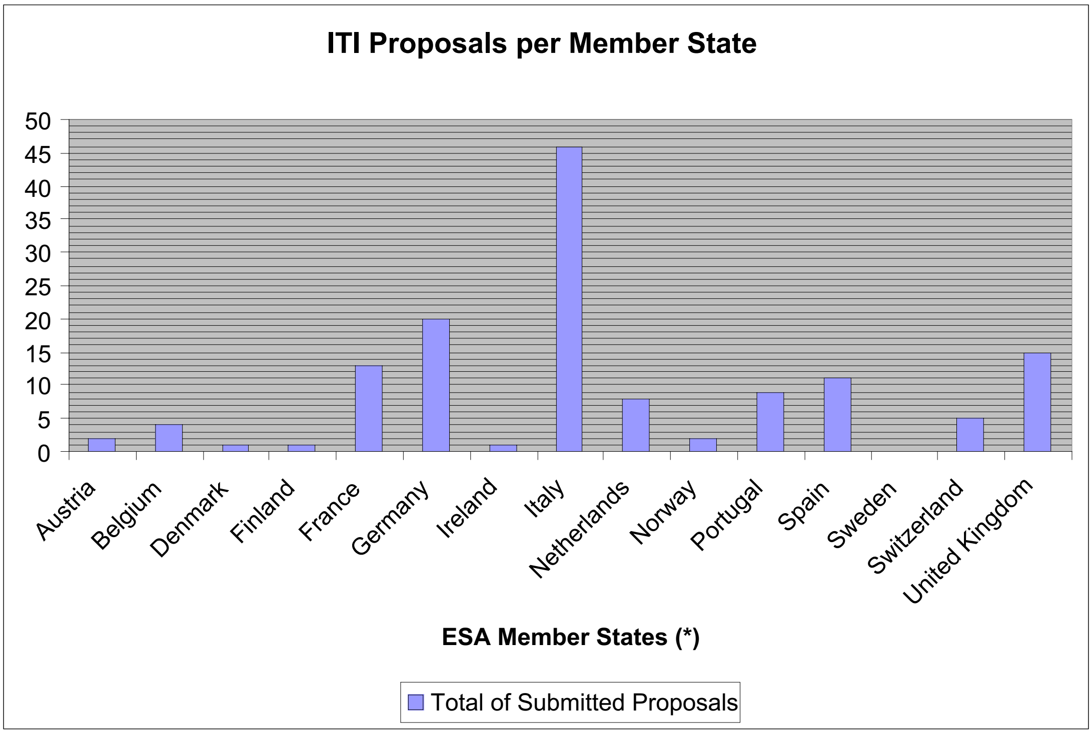
The online submission of proposals using ESA pre-defined templates has many advantages. The templates help the submitters to focus on providing the essential information, and gives clear guidelines which are particularly useful for the companies who have less experience in submitting proposals to ESA. For the ESA experts who evaluate the ITI proposals, this procedure is also quite useful, because templates guarantee that the proposals are, at the same time, concise and complete.

The efficiency of this online templates-based procedure for submitting ITI proposals was indeed the main reason that explains how the small ITI management team was able to process so many ITI proposals during the first year of operation.

4 THE RESULTS ACHIEVED IN THE FIRST YEAR OF ITI

The high interest on ITI shown by the European industry resulted in 138 proposals that were submitted during the first year of operation of the initiative.

Figure 2 gives the distribution per country of the number of submitted proposals, to ITI in 2004. This figure shows also that companies or institutes from almost all ESA Member States (MS) have participated to ITI.



(*): Greece and Luxembourg have only become ESA MS after the 2004 ITI Announcement of Opportunity (AO). Entities from these 2 countries will be able to bid for the 2005 ITI AO, though.

Figure 2 - Distribution per Member State of the submitted proposals to ITI in 2004

Out of the 138 proposals received, the ITI evaluation board retained 27 for funding - almost one fifth.
The 27 projects selected cover a wide range of the technologies for spacecraft and missions: Mechanical systems, structures, materials, processes, pyrotechnics, instrumentation, optics, computer systems, software propulsion, automation and robotics (see figure 3).

A summary of ITI activities already concluded is provided on the ITI web site: https://iti.esa.int/

ITI aims at validating specific technologies or concepts and not in supporting system studies, which have a rather broad approach in trying to find an 'optimal solution' to a given problem. The scope of ITI instead, is to further validate an already identified specific and apparently advantageous solution to a space application that need or can be substantially improved. As a consequence, some technical domains which are usually the subject of an initial system study approach (e.g. TD8 – System Design and Verification) have a 1 to 7 ratio of approved over rejected proposals.

Conversely, in other technical domains is relatively easy for the proposed ideas to be highly innovative and present clear benefits for a specific space application. This is the case for TD15 – Mechanisms & Tribology, or TD23 – Materials & Processes. The approval rate of ITI proposals in this area is around 50%.

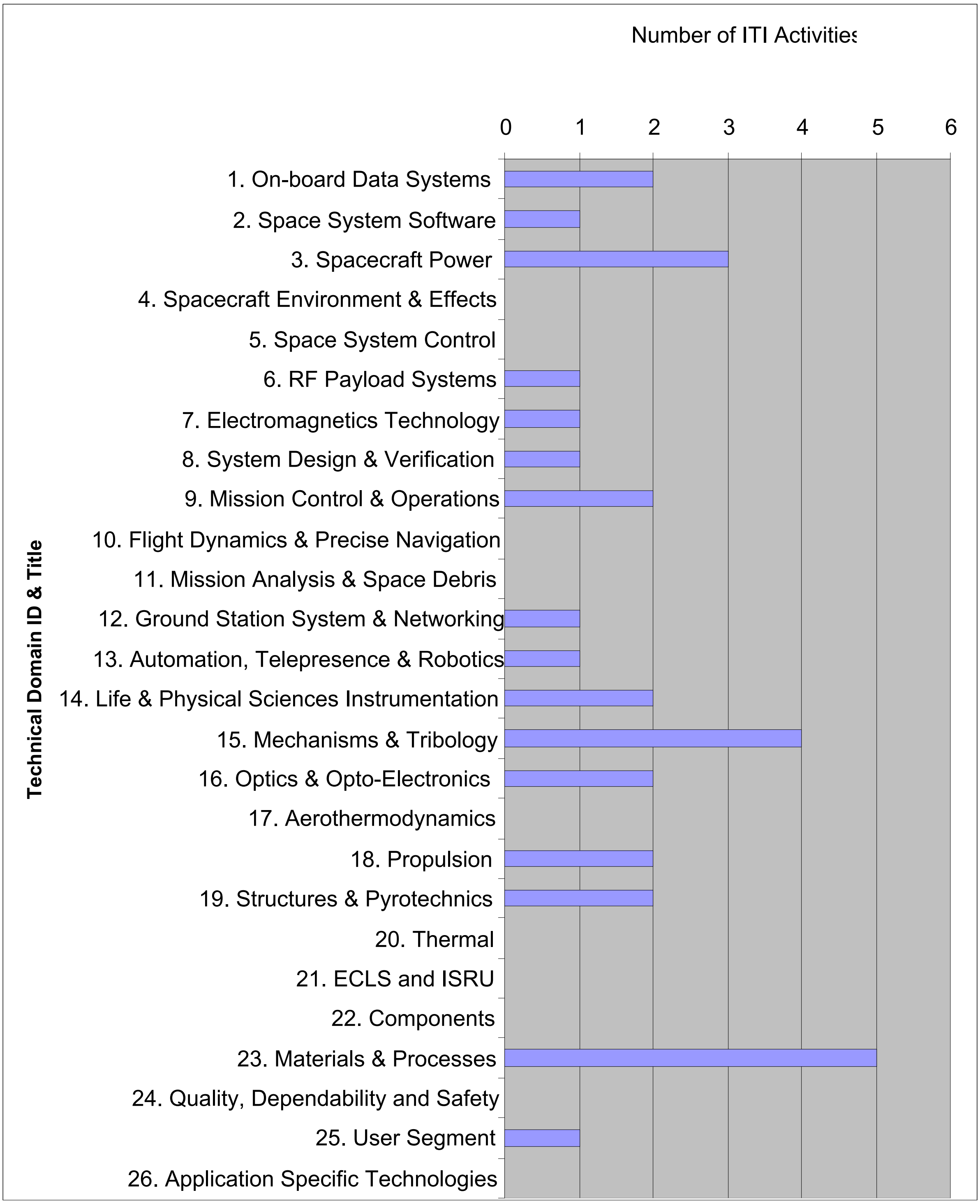


Figure 3 - Distribution of the ITI approved activities per Technical Domain (*includes the 4 activities selected during the ITI Pilot Phase*)

5 THE LESSONS LEARNED AND THE WAY FORWARD

There was clearly a need, especially from the European Space industry side, for an initiative with the philosophy of ITI, which gives an opportunity for an early stage assessment of the validity of innovative ideas for space applications. The existence of this need can partially explain the high participation of industry in ITI. But this high participation can also be explained by some operation characteristics, namely by the fact that ITI:

- accepts unsolicited proposals
- is not constrained to any specific technical domain
- is open during a large period of the year
- takes a funding decision in a relatively short time
- has a submission procedure which implies very low costs to industry in order to prepare/submit/manage R&D proposals.

Nevertheless, some aspects, related with the submission templates and with the ITI Web application, can be improved.
During the first year of ITI, the Tender Evaluation Board evaluated many proposals that were found to be out of scope. Therefore the Statement of Work for the ITI 2005 Announcement of Opportunity clearly states which characteristics shall an ITI proposal be compliant to. Proposals that are not compliant to what is demanded in the Statement of Work will be immediately rejected and not subjected to a deeper technical evaluation.
The submission templates have been updated throughout the last year. The additional improvements that were identified include:

- Providing the submitters with the possibility to upload a cover letter indicating their acceptance and compliance to the General Clauses and Conditions for ESA Contracts
- A new field to specify the splitting of the money between the bidding partners
- Providing the submitters with the possibility to upload a letter signed by the customers, where it is specified their Industrial Interest.

These changes will be implemented on the next release of the ITI Web application.

6 CONCLUSIONS

The results achieved in this first year of ITI are above all initial expectations, especially with respect to the number and diversity of the received proposals. In addition, the limited resources employed in the successful management of ITI have fully validated the basic principles of the initiative. Therefore, in the authors' opinion, ITI has proven to be a sound complement to existing ESA technology programmes.

In conclusion, ITI promotes a closer collaboration between inventors, developers and customers, generating a constructive synergy for fast technology development projects. ITI is particularly interesting for entities with less experience in leading with the agency, because it gives them an opportunity to approach the companies already implemented in the space market. The long-term objective is to help to establish a highly creative and dynamic industrial environment in Europe, thus contributing to a more competitive European space industry.

Therefore ITI is planned to run also in 2005 with very few adjustments on the evaluation procedure. The ITI dedicated web site - https://iti.esa.int/ - gives updated information on the project criteria, requirements and schedule.

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